**Lesson 5 – Phylogenetics and Cladograms (Kyle Barrett)**

**Overview** - This lesson introduces students to the use of visual representations of the relationships between organisms. These useful tools, phylogenetic trees and cladograms, are essentially graphic organizers used by evolutionary biologists. Students will learn their purpose, their meaning, and how to create their own versions.

**Standards –** Standards are those provided in the “Next Generation Science Standards”. Learning objectives based on standards specifically applicable to this lesson:

NGSS HS-LS4-1: Students will be able to create graphic representations of organism relationships (phylogenetic trees and cladograms) that reflect common ancestry and evolutionary concepts (phenotypic similarities, genetic commonalities).

**Materials / Preparation Checklist**

PowerPoint Presentation (teacher prepared)

Computer and projector for PowerPoint presentation

Whiteboard for additional explanations / descriptions (as needed)

Whiteboard markers

Phylogenetic Tree worksheet

Cladogram Analysis worksheet

**Objectives**

|  |  |  |
| --- | --- | --- |
| Objective | How I will assess during lesson. | How I will assess after lesson. |
| Describe components of a phylogenetic tree | Provide scaffolding as needed during discussions | Evaluate phylogenetic worksheet answers |
| Explain the meaning of a phylogenetic tree | Expand upon content when informal instant assessment suggests student confusion | Evaluate phylogenetic worksheet answers |
| Create a cladogram and explain its meaning and purpose | Monitor student performance and determine level of understanding | Evaluate cladograms and student explanations |

**Opening**

Students will be greeted as they enter. On the board will be listed their introductory assignment: in their journals, they should brainstorm all they know about trees (of any kind), with emphasis on descriptors.

Once they begin, “housekeeping” will occur, with attendance taken and any other administrative actions completed. Lesson 3 essays will be collected, as well as lesson 4 “Natural Selection” worksheets.

Upcoming Requirements: On the board will be a reminder that the Unit Assessment will occur during the 7th class meeting for this unit (next Thursday).

Day Goals: The “Key Take-Aways” will be listed on the board: Taxonomy, Phylogenetic, Cladogram

Transition: Students will report out the results of their brainstorming efforts. A main focus will be on descriptions – how trees are organized, with ever-smaller branches as one gets further from the main trunk. Once that point has been made, the teacher will announce that today another kind of tree will be studied, that shares many of the characteristics described – a phylogenetic tree.

**Instruction**

|  |  |  |
| --- | --- | --- |
| Instructional  Step | Teacher Actions/Questions (I will do/say...) | Student Actions/Instructions (Student will...) |
| 1 | Provide a PowerPoint brief on the main lesson topics: Linnaeus, Binomial Taxonomy, Construction and Interpretation of Phylogenetic Trees, DNA use in determining relationships between organisms, Cladistics, Cladograms, and Character Tables. | Take notes |
| 2 | Ask questions during presentation, and refer frequently to earlier lessons to activate prior knowledge | Respond to questions  Generate questions |
| 3 | Distribute worksheets on Phylogenetic Trees | Independently complete worksheets |
| 4 | Monitor student performance during seatwork | Submit worksheet upon completion |
| 5 | Discuss phylogenetic tree worksheet | Respond to queries |
| 6 | Distribute cladogram worksheet; read over instructions with class | Complete worksheet activities with partner (but both must submit worksheets for grade) |
| 7 | Direct and monitor students actions as needed during pair work |  |
| 8 | Request student volunteers (who did not work together) to draw their cladograms on the whiteboard | Volunteers explain how cladogram was created |

**Accommodations**

Vocabulary worksheets for ELL or struggling learners will enable them to familiarize themselves with key terms prior to class work. A list of selected video clips will be available for those who are more visual learners (to be viewed at home). These clips will reinforce the key concepts.

**Closing**

Students will complete exit ticket. “What aspects of what we have studied thus far do you find confusing?” The teacher will use the responses to plan the review for the unit assessment.

**Notes / Resources**

This lesson plan is adapted from one created by Nicolle Wambold, Sierra Nevada College

<http://nicollewambold.wikispaces.com/file/view/Evolution+Unit+Plan.pdf/244787767/Evolution%20Unit%20Plan.pdf>



Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Period: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**CLADOGRAM ANALYSIS**

What is a cladogram? It is a diagram that depicts evolutionary relationships among

groups. It is based on PHYLOGENY, which is the study of evolutionary relationships.

Sometimes a cladogram is called a phylogenetic tree (though technically, there are

minor differences between the two).

In the past, biologists would group organisms based solely on their physical appearance.

Today, with the advances in genetics and biochemistry, biologists can look more closely

at individuals to discover their pattern of evolution, and group them accordingly - this

strategy is called EVOLUTIONARY CLASSIFICATION.

CLADISTICS is form of analysis that looks at features of organisms that are considered

"innovations", or newer features that serve some kind of purpose. (Think about what the

word "innovation" means in regular language.) These characteristics appear in later

organisms but not earlier ones and are called DERIVED CHARACTERS.

PART I - Analyze the Cladogram

Examine the sample cladogram, each letter on the diagram points to a derived

character, or something different (or newer) than what was seen in previous groups.

Match the letter to its character. Note: this cladogram was created for simplicity and

understanding, it does not represent the established phylogeny for insects and their

relatives.

1. \_\_\_\_\_\_ Wings

2. \_\_\_\_\_\_ 6 Legs

3. \_\_\_\_\_\_ Segmented Body

4. \_\_\_\_\_\_ Double set of wings

5. \_\_\_\_\_\_ Jumping Legs

6. \_\_\_\_\_\_ Crushing mouthparts

7. \_\_\_\_\_\_ Legs

8. \_\_\_\_\_\_ Curly Antennae

Continued

PART II - Create Your Own Cladogram

To make a cladogram, you must first look at the animals you are studying and establish

characteristics that they share and ones that are unique to each group. For the animals

on the table, indicate whether the characteristic is present or not. Based on that chart,

create a cladogram like the one pictured above.



Draw Your Cladogram Below: